

Original Article

Prevalence of tongue disorders and tongue coating colours among patients with type II diabetes mellitus

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Abstract

A coated tongue represents a clinically relevant parameter in the visual diagnosis of systemic conditions. Given that Diabetes Mellitus is among the most prevalent metabolic disorders worldwide, with an especially high burden in India, the early identification of such clinical markers is of substantial importance for timely screening and intervention. The oral cavity mirrors systemic illness, and oral manifestations are associated with diabetes. This study evaluated the prevalence of tongue coating colours and location in type II diabetic patients. Tongue colours were classified according to six categories (Liyan Chen *et al.*), and coating location assessed using Kojima Parameters. Common tongue abnormalities were also recorded. The study found that pink-coloured coating was most prevalent, followed by yellow and white. Nearly half of the patients showed a thin coating on less than one-third of the back of the tongue. Glossitis and candidiasis were the most frequent abnormalities. These findings highlight the role of tongue examination as a non-invasive method for suspecting diabetes in undiagnosed patients, thereby supporting early screening and treatment.

Keywords: tongue coating, diabetes mellitus, non-invasive diagnosis, community health screening, oral-systemic link

Introduction

Diabetes Mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia, the severity of which is directly associated with the development of systemic complications across all age groups. Notably, oral manifestations often present as early complications and may serve as valuable indicators for the initial diagnosis of the disease [1].

Several studies have established a strong association between tongue alterations and systemic diseases. With India recognized as the diabetic capital of the world, a significant proportion of cases remain

undiagnosed or poorly controlled. As the oral cavity frequently reflects systemic health, numerous oral manifestations, including tongue changes, have been documented in relation to Diabetes Mellitus [2]. In traditional East Asian medicine, tongue coating is regarded as a clinical sign of Diabetes Mellitus. However, limited epidemiological evidence exists regarding the association between tongue coating and the prevalence of type 2 diabetes in the general population [3].

Among the various oral manifestations observed in patients with Diabetes Mellitus, tongue lesions, often overlooked in clinical practice, warrant particular attention. Reported abnormalities include glossitis,



atrophic tongue lesions, median rhomboid glossitis, geographic tongue, coated tongue, fissured tongue, glossodynia, burning mouth sensation, and altered taste perception, all of which occur with increased frequency in diabetic individuals. The severity of these manifestations is frequently correlated with both the duration and degree of hyperglycemia [1].

Therefore, we intended to study various tongue disorders and coatings of diabetic patients which will provide insight to clinicians for early diagnosis of diabetes mellitus.

The aim and objectives of this study are to assess the colour and location of tongue coating among patients with type II diabetes mellitus, to analyse the presence of various tongue disorders in these patients, and to estimate the prevalence rate of tongue disorders and tongue coating colours within the studied population.

Material and methods

Sampling procedure

This is an observational study carried out on a study model of 200 people from various professions and walks of life with an acceptable profile. The subjects were selected from the people visiting the Outpatient Department of A. B. Shetty Memorial Institute of Dental Sciences, Mangalore, India, in the age group of 18–60 years.

Selection criteria

All patients previously diagnosed with type 2 diabetes mellitus and receiving oral hypoglycaemic agents were included in the study, while patients with type 1 diabetes mellitus, malignancies, chronic systemic bacterial infections, those undergoing chemotherapy or radiotherapy, patients on immunosuppressive drug therapy, and denture wearers were excluded.

Methodology

The materials used in this study included artificial light, a mouth mirror, a tongue depressor, gauze, and a digital camera. A thorough medical history was obtained from each patient, followed by a systematic clinical examination of the tongue, and all findings were documented using a case study form. The diagnosis of a coated tongue was made through clinical examination by direct visualization or with the assis-

tance of a mouth mirror, artificial light, and a tongue depressor. Tongue colour was assessed by comparing it with six standard colour categories—pink, pale, purple, purple-red, yellow coating, and white coating—as classified by Liyan Chen *et al.*, and the prevalence of each colour was determined accordingly. The location and extent of tongue coating were evaluated using the Kojima Index, which ranges from no coating to thick coating covering more than two-thirds of the tongue, and the prevalence of tongue coating was calculated based on these scores. In addition to tongue coating, other tongue abnormalities assessed included glossitis, candidiasis, oral hairy leukoplakia, geographic tongue, fissured tongue, altered taste sensation, burning sensation, and atrophic tongue.

Statistical analysis

Data were analysed using SPSS v26. Descriptive statistics (frequency and percentages) were applied. Associations between tongue coating colour/location and patient characteristics were assessed using Chi-square test. Statistical analysis was performed with results expressed as p-values and 95% confidence intervals, with $p < 0.05$ considered statistically significant.

Results

Out of a pool of 200 patients, the most common coating colour was pink, followed by pale and yellow. White, purple, and purple-red coatings were less frequent (Figure 1). Nearly half of the patients showed a thin coating covering less than one-third of the posterior tongue (Kojima Index score 1), while fewer cases presented with extensive thick coatings (Figure 2). The association between coating severity and duration of diabetes was statistically significant ($p = 0.032$).

Tongue abnormalities were also observed, the most frequent being glossitis and candidiasis. Burning sensation, altered taste, and leukoplakia were noted in smaller proportions, while geographic, fissured, and atrophic tongue appeared rarely (Figure 3).

Discussion

The present study highlights a significant prevalence of tongue coating and related abnormalities among type II diabetic patients. Pink coating was the most common, followed by yellow and white, findings

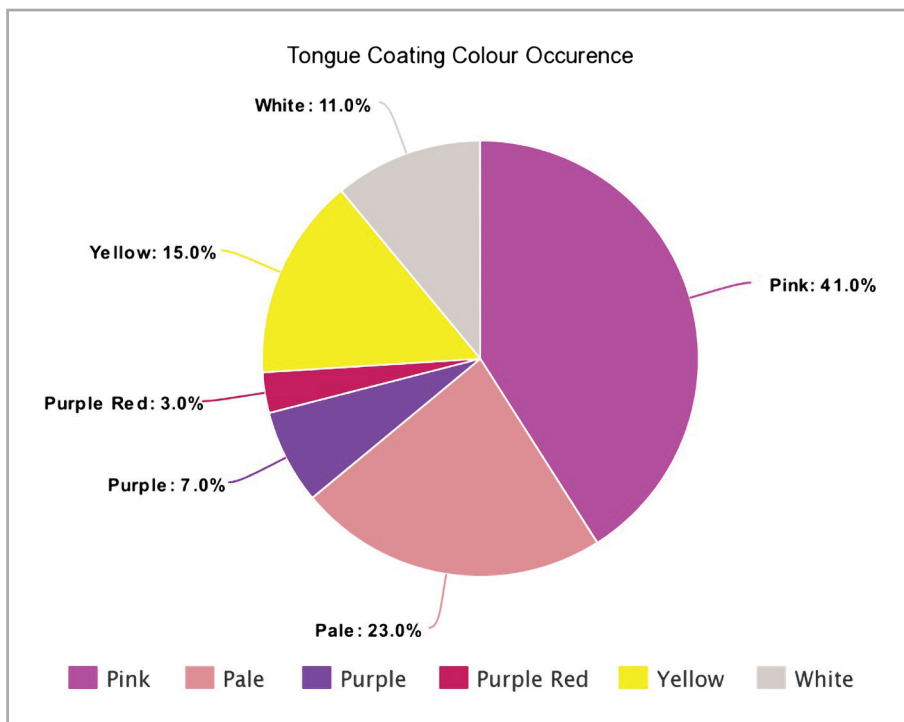


Figure 1: Tongue coating colour distribution among population.

comparable to Chen et al. [4]. Tomooka et al. [3] also reported yellow coating as strongly associated with diabetes, supporting our observation of its moderate prevalence [5, 6]. The predominance of Kojima Index score 1 suggests that thin posterior tongue coatings may represent an early oral manifestation of diabetes.

Glossitis and candidiasis were the most common abnormalities, consistent with earlier prevalence studies [2, 7, 8]. Recent research published by Balamanikandan et al. and other studies also emphasized the diagnostic potential

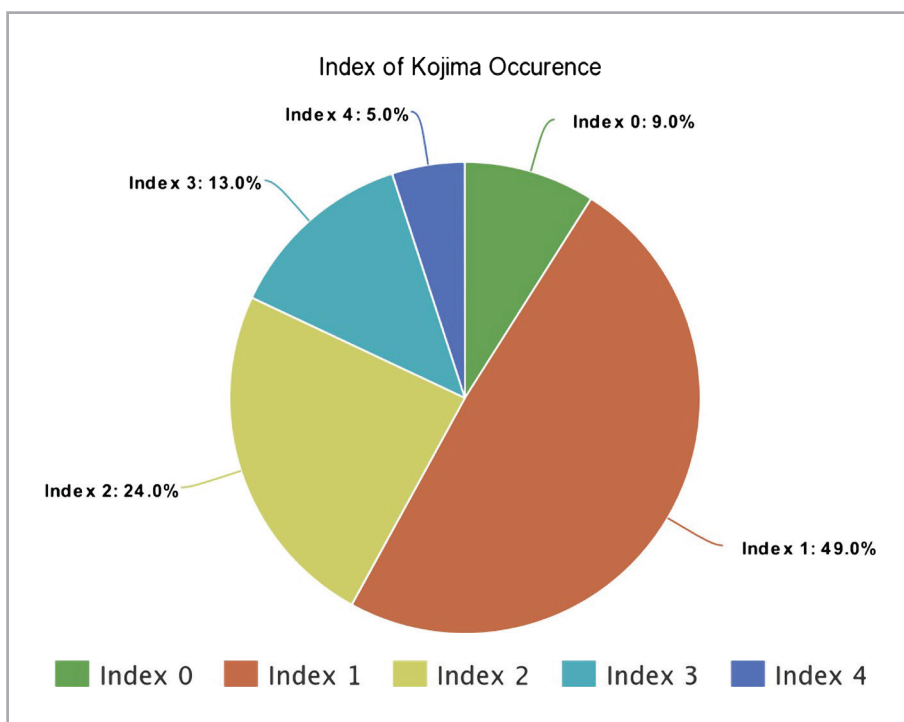


Figure 2: Tongue coating thickness distribution among population.

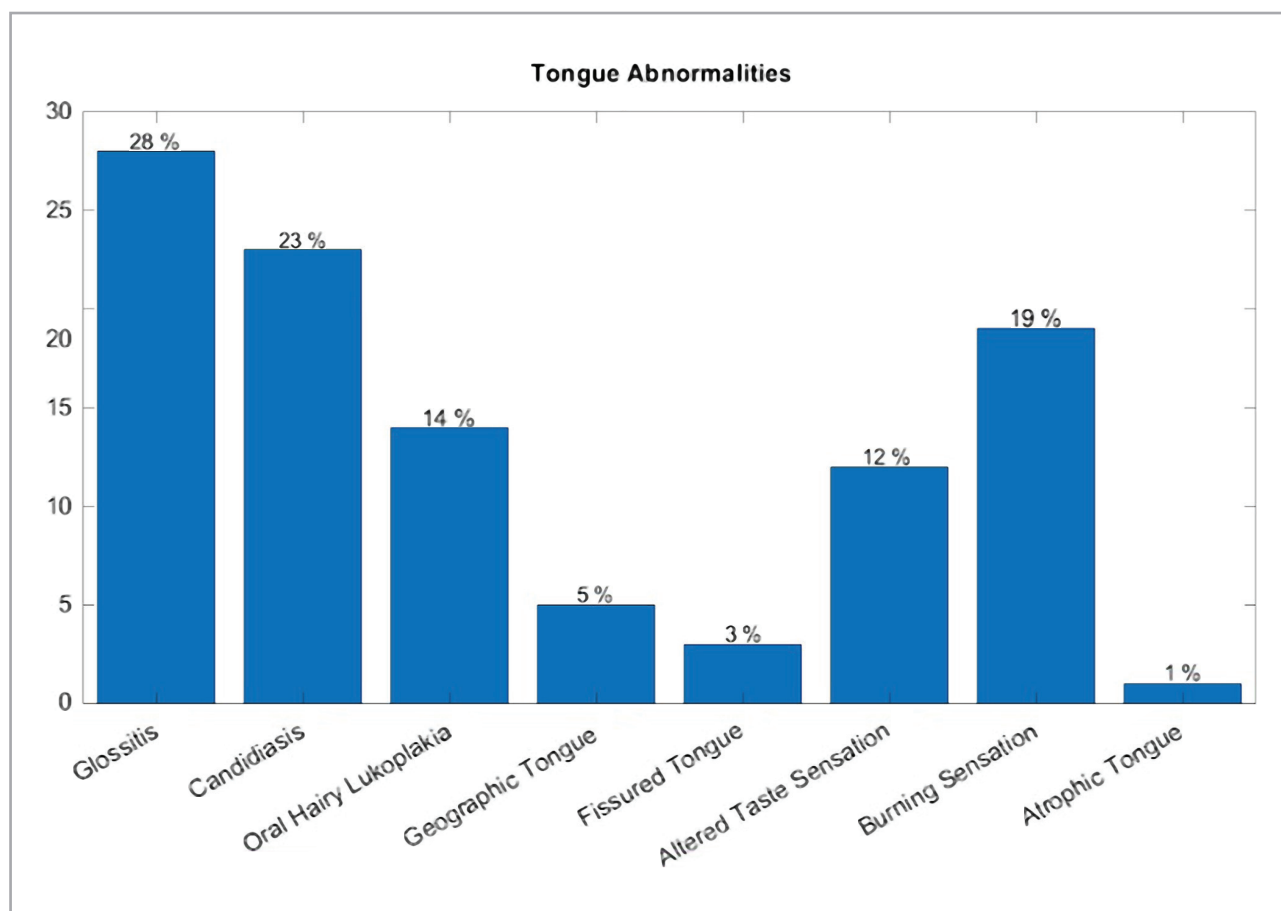


Figure 3: Tongue abnormalities among population.

of tongue changes in diabetic patients, further validating our findings [9, 10].

The strengths of this study include a relatively large sample size and the use of standardised assessment methods (Kojima Index, Chen colour classification). Limitations include its single-centre design and lack of correlation with HbA1c values or other glycaemic indices. Future research should focus on multi-centre studies, integrating biochemical parameters to better validate tongue diagnosis as a screening tool.

Overall, the results reinforce the potential role of tongue examination as a simple, non-invasive method to raise suspicion of diabetes, especially in dental or community settings, and to encourage timely referral for diagnostic testing.

Conclusion

Tongue diagnosis serves as an important clinical tool in the prognosis and management of Diabetes Mellitus. This study reveals significant evidence of the presence of colour-coated tongue among diabetic patients under

oral hypoglycemic drugs. The prevalence of different colours of the coated tongue, along with its location, is statistically analysed. This study highlights the potential of non-invasive diagnosis through tongue manifestations, which can serve as a valuable tool in community health screening to identify individuals unaware of their diabetic status. Furthermore, it emphasizes the oral-systemic link, as changes observed in the oral cavity may reflect underlying systemic conditions like diabetes, enabling earlier detection and effective management.

Conflict of interest

The authors declare no conflict of interest.

Ethics approval

This study was approved by the Institutional Ethics Committee of NITTE (Deemed to be University), A. B. Shetty Memorial Institute of Dental Sciences, Mangalore, India (ETHICS/ABSMIDS/390/2023).

Consent to participate

Written informed consent was obtained from all the participants.

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